

4/27/04

09/873,537

FILE 'HCAPLUS' ENTERED AT 14:30:50 ON 27 APR 2004

L1 1251 S (TWIN# OR TWINNED OR TWO OR PAIR#### OR DUAL?) (A) DAMASCENE#

L2 586 S ANTIFUSE? OR ANTI(W) FUSE? OR FPIC OR FPGA

L3 1433460 S VIA OR VIAS OR SPACE OR SPACES OR WINDOW# OR OPEN##### OR  
INTERCONN?

L4 602528 S PATTERN####

L5 591919 S (ILD OR DIELECT##### OR INSULAT? OR NONCONDUCT? OR  
NON(W) CONDUCT? OR DIELEC? OR INSULAT? OR OXIDE(W) (LAYER? OR  
FILM##### OR COAT?))

L6 4 S L1 AND L2 AND L3

L7 6661 S L4 (3A) L5

L8 1 S L6 AND L7

L9 3 S L6 NOT L8

Set	Items	Description
S1	755	(TWIN? ? OR TWINNED OR TWO OR PAIR???? OR DUAL?) (N) DAMASCENE? ?
S2	4989	ANTIFUSE? OR ANTI (W) FUSE? OR FPIC OR FPGA
S3	0	MC=(U11-C05G2A OR U11-D03B2? OR U12-C04 OR U14-D01A OR U14-A06B1)
S4	271	IC=(H01L-023/525)
S5	5161	S2:S4
S6	1130556	VIA OR VIAS OR SPACE OR SPACES OR WINDOW? ? OR OPEN????? OR INTERCONN?
S7	0	MC=(U11-C05D3 OR U11-C07D2 OR U11-C05G2 OR U11-D03B3 OR U11-D03C3 OR L04-C13B)
S8	998	IC=(H01L-021/88 OR H01L-023/535 OR H01L-023/538 OR H01L-021/88 OR H01L-021/90)
S9	1130828	S6:S8
S10	292074	PATTERN????
S11	3	S1 AND S5 AND S9 AND S10 (3N) (ILD OR DIELECT????? OR INSULAT? OR NONCONDUCT? OR NON(W) CONDUCT? OR DIELEC? OR INSULAT? OR OXIDE (W) (LAYER? OR FILM????? OR COAT?))
S12	4	S1 AND S5 AND S9 AND S10 NOT S11

File 348: **EUROPEAN PATENTS** 1978-2004/Apr W02

(c) 2004 European Patent Office

File 349: **PCT FULLTEXT** 1979-2002/UB=20040415,UT=20040408

(c) 2004 WIPO/Univentio

File 350:Derwent WPIX 1963-2004/UD,UM &UP=200426

(c) 2004 Thomson Derwent

Set	Items	Description
S1	1179	(TWIN? ? OR TWINNED OR TWO OR PAIR???? OR DUAL?) (N)DAMASCENE? ?
S2	3916	ANTIFUSE? OR ANTI(W)FUSE? OR FPIC OR FPGA OR FIELD(3N)PROGRAM????
S3	12218	MC=(U11-C05G2A OR U11-D03B2? OR U12-C04 OR U14-D01A OR U14-A06B1)
S4	332	IC=(H01L-023/525)
S5	15624	S2:S4
S6	2315721	VIA OR VIAS OR SPACE OR SPACES OR WINDOW? ? OR OPEN????? OR INTERCONN?
S7	31202	MC=(U11-C05D3 OR U11-C07D2 OR U11-C05G2 OR U11-D03B3 OR U11-D03C3 OR L04-C13B)
S8	12691	IC=(H01L-021/88 OR H01L-023/535 OR H01L-023/538 OR H01L-021/88 OR H01L-021/90)
S9	2342752	S6:S8
S10	361534	PATTERN????
S11	19	S1 AND S5 AND S9 AND S10(3N) (ILD OR DIELECT????? OR INSULAT? OR NONCONDUCT? OR NON(W)CONDUCT? OR DIELEC? OR INSULAT? OR OXIDE(W) (LAYER? OR FILM? OR COAT?))
S12	40	S1 AND S5 AND S9 AND S10
S13	3	S2 AND S12
S14	2	S13 NOT PN=US2001036750
S15	2	S14 NOT S11

Set	Items	Description
S1	1539	(TWIN? ? OR TWINNED OR TWO OR PAIR???? OR DUAL?) (N)DAMASCENE? ?
S2	18011	ANTIFUSE? OR ANTI(W)FUSE? OR FPIC OR FPGA
S3	5739605	VIA OR VIAS OR SPACE OR SPACES OR WINDOW? ? OR OPEN????? OR INTERCONN?
S4	3513	PATTERN????(3N) (ILD OR DIELECT????? OR INSULAT? OR NONCONDUCT? OR NON(W)CONDUCT? OR DIELEC? OR INSULAT? OR OXIDE(W) (LAYER? OR FILM? OR COAT?))
S5	0	S1 AND S2 AND S3 AND S4
S6	1548	(TWIN? ? OR TWINNED OR TWO OR PAIR???? OR DUAL?) (2N)DAMASCENE? ?
S7	45711	ANTIFUSE? OR ANTI(W)FUSE? OR FPIC OR FPGA OR PROGRAM? (3N) FIELD
S8	0	S6 AND S7
File	2:	<b>INSPEC</b> 1969-2004/Apr W3 (c) 2004 Institution of Electrical Engineers
File	6:	<b>NTIS</b> 1964-2004/Apr W4 (c) 2004 NTIS, Intl Cpyrght All Rights Res
File	8:	<b>Ei Compendex</b> (R) 1970-2004/Apr W2 (c) 2004 Elsevier Eng. Info. Inc.
File	25:	<b>Weldasearch</b> 19662004/Nov (c) 2004 TWI Ltd
File	34:	<b>SciSearch</b> (R) Cited Ref Sci 1990-2004/Apr W3 (c) 2004 Inst for Sci Info
File	434:	<b>SciSearch</b> (R) Cited Ref Sci 1974-1989/Dec (c) 1998 Inst for Sci Info
File	35:	<b>Dissertation Abs Online</b> 1861-2004/Mar (c) 2004 ProQuest Info&Learning
File	65:	<b>Inside Conferences</b> 1993-2004/Apr W4 (c) 2004 BLDSC all rts. reserv.
File	94:	<b>JICST-EPlus</b> 1985-2004/Apr W2 (c)2004 Japan Science and Tech Corp(JST)
File	99:	<b>Wilson Appl. Sci &amp; Tech Abs</b> 1983-2004/Mar (c) 2004 The HW Wilson Co.
File	103:	<b>Energy SciTec</b> 1974-2004/Apr B1 (c) 2004 Contains copyrighted material
File	144:	<b>Pascal</b> 1973-2004/Apr W3 (c) 2004 INIST/CNRS
File	239:	<b>Mathsci</b> 1940-2004/Jun (c) 2004 American Mathematical Society
File	241:	<b>Elec. Power DB</b> 1972-1999Jan (c) 1999 Electric Power Research Inst.Inc
File	305:	<b>Analytical Abstracts</b> 1980-2004/Apr W2 (c) 2004 Royal Soc Chemistry
File	315:	<b>ChemEng &amp; Biotec Abs</b> 1970-2004/Mar (c) 2004 DECHEMA
File	354:	<b>Ei EnCompassLit</b> (TM) 1965-2004/Apr W2 (c) 2004 Elsevier Eng. Info. Inc.
File	987:	<b>TULSA</b> (Petroleum Abs) 1965-2004/Apr W4 (c)2004 The University of Tulsa

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15/9/1

DIALOG(R) File 350:Derwent WPIX

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013465697 WPI Acc No: 2000-637640/200061

Fabrication of **anti-fuse** module and **dual damascene interconnect** structure involves forming metal line, depositing and **patterning** silicon nitride and fusing element layers, and forming **anti-fuse** metal line and **interconnect**

Patent Assignee: CHARTERED SEMICONDUCTOR MFG LTD PTE (CHAR-N)

Inventor: CHU S S; LEE C; SHAO K; XU Y

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6124194	A	20000926	US 99439365	A	19991115	200061 B

Abstract (Basic): US 6124194 A

NOVELTY - An **anti-fuse** module and **dual damascene interconnect** structure is fabricated by forming a first metal line, depositing and **patterning** silicon nitride layer, depositing and **patterning** a fusing element layer, and simultaneously forming an **anti-fuse** line and a **dual damascene interconnect** on and contacting with a second metal line.

DETAILED DESCRIPTION - An **anti-fuse** module and **dual damascene interconnect** structure is fabricated by forming a first metal **via** within a first dielectric layer (20) within an **anti-fuse** area (16) and contacting a first metal line (12); depositing a silicon nitride (SiN) layer on the dielectric layer and metal **via** (26); **patterning** the SiN layer (28) to form at least two **openings**; depositing and **patterning** a fusing element layer on the **patterned** SiN layered structure to form a fusing element on the metal **via**; and simultaneously forming an **anti-fuse** metal line (56) on the fusing element (44) to form an **anti-fuse** module within the **anti-fuse** area, and a **dual damascene interconnect** (58) and contacting with a second metal line and within the **interconnect** area (18). A first **opening** exposes the first metal **via** and a second **opening** exposes a portion of the first dielectric layer above the second metal line (14).

USE - For fabricating an **anti-fuse** module and **dual damascene interconnect** structure.

ADVANTAGE - The invention can be used with a **dual damascene** process without damaging the **via** portion of the **dual damascene interconnect** structure. The module is on a smaller design rule because a **dual damascene** process provides a very advanced design for local **interconnections**.

DESCRIPTION OF DRAWING(S) - The figure shows a cross-sectional representation of the invention.

- First metal line (12)
- Second metal line (14)
- Anti-fuse** area (16)
- Interconnect** area (18)
- First dielectric layer (20)
- Metal **via** (26)
- SiN layer (28)
- Tantalum nitride (36)
- Amorphous silicon (38)
- Fusing element (44)
- Anti-fuse** metal line (56)

**Dual damascene interconnect (58)**

## Technology Focus:

TECHNOLOGY FOCUS - INORGANIC CHEMISTRY - Preferred Material: The first metal **via** comprises metal from tungsten, aluminum, or copper. The fusing element layer and fusing element comprise a lower layer of tantalum nitride (36), a middle layer of amorphous silicon (38), and an upper layer of tantalum nitride. The first dielectric material comprises a low dielectric constant material. The **anti-fuse** metal line and **dual damascene interconnect** is formed from copper.

Title Terms: FABRICATE; ANTI; FUSE; MODULE; DUAL; **INTERCONNECT**; STRUCTURE; FORMING; METAL; LINE; DEPOSIT; **PATTERN**; SILICON; NITRIDE; FUSE; ELEMENT; LAYER; FORMING; ANTI; FUSE; METAL; LINE; **INTERCONNECT**

Derwent Class: L03; U11

International Patent Class (Main): H01L-029/00

File Segment: CPI; EPI

Manual Codes (CPI/A-N): L04-C10A; **L04-C13B**

Manual Codes (EPI/S-X): **U11-C05D3**; **U11-C05G2A**; U11-C05G2C; **U11-D03B2A**

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DIALOG(R) File 350:Derwent WPIX

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011153888 WPI Acc No: 1997-131812/199712 Related WPI Acc No: 1998-086264

**Dual damascene anti-fuse** structure mfr. with reduced cost - including deposition of process control layer over **anti-fuse** structure and etching of **opening** in process control layer, etc.

Patent Assignee: CHARTERED SEMICONDUCTOR MFG LTD PTE (CHAR-N); CHARTERED SEMICONDUCTOR MFG PTE LTD (CHAR-N)

Inventor: CHAN L; ZHENG J Z; ZHENG J

Patent No	Kind	Date	Applicat No	Kind	Date	Week
<b>US 5602053</b>	<b>A</b>	<b>19970211</b>	<b>US 96628068</b>	<b>A</b>	<b>19960408</b>	<b>199712 B</b>
SG 52951	A1	19980928	SG 971108	A	19970408	199904

Abstract (Basic): US 5602053 A

Mfr. of an **antifuse** structure comprises: (a) providing a 1st conductive layer; (b) depositing a 1st insulating layer on the 1st conductive layer; (c) **patterning** and etching the 1st insulating layer to form a trench; (d) **patterning** and etching the 1st insulating layer, including the trench to form a cavity extending from inside the trench down to the level of the 1st conductive layer; (e) depositing a barrier layer on the 1st insulating layer and on all walls of the trench and the cavity; (f) depositing a 2nd conductive layer so as to more than fill the cavity and the trench; (g) removing the 2nd conductive layer and the barrier layer as far as the level of the 1st insulating layer to form a 1st **dual damascene** connector (DDC) having an upper surface; (h) depositing a 1st layer of Si nitride on the **antifuse** structure; (i) depositing a 1st layer of amorphous Si on the nitride layer; (j) depositing a 2nd layer of Si nitride on the 1st layer of amorphous Si; (k) depositing a 2nd layer of amorphous Si on the 2nd layer of nitride; (l) **patterning** and then etching the 1st and 2nd layers of Si nitride and amorphous Si to form a pedestal that overlaps the 1st DDC; (m) depositing a 2nd insulating layer on the 1st insulating layer and on the 2nd layer of amorphous Si; and (n) forming a 2nd DDC that extends through the 2nd insulating layer

See HCAPLUS HIT L9#3

down to and making electrical contact with the 2nd layer of amorphous Si.

Also claimed is a process as above further comprising between steps (g) and (h), the deposition of a process control layer over the **antifuse** structure and the etching of an **opening** in the process control layer to fully expose the upper surface of the DDC.

USE - **Antifuse** structure for programmable logic and memory devices.

ADVANTAGE - Fewer mfg. steps, reduced costs and improved reliability i.e. all electrically active surfaces of the **antifuse** structure are planar.

Dwg.5/6

Title Terms: DUAL; ANTI; FUSE; STRUCTURE; MANUFACTURE; REDUCE; COST; DEPOSIT; PROCESS; CONTROL; LAYER; ANTI; FUSE; STRUCTURE; ETCH; **OPEN**; PROCESS; CONTROL; LAYER

Index Terms/Additional Words: PROGRAMMABLE; MEMORY; LOGIC; DEVICE

Derwent Class: L03; U11

International Patent Class (Main): H01L-021/70

File Segment: CPI; EPI

Manual Codes (CPI/A-N): L03-G04A; L04-C14

Manual Codes (EPI/S-X): **U11-C05G2A; U11-D03B2A**

11/3,k/2 (Item 1 from file: 349)  
 DIALOG(R) File 349:PCT FULLTEXT  
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00895724 \*\*Image available\*\*

HIGH-DENSITY METAL CAPACITOR USING **DUAL-DAMASCENE** COPPER  
**INTERCONNECT**

Patent Applicant/Assignee:

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Patent Applicant/Inventor:

TSAU Liming, 16215 Alton Parkway, Irvine, CA 92618-3616, US, US

Patent and Priority Information (Country, Number, Date):

Patent: **WO 200229892** A2-A3 20020411 (WO 0229892)

Application: **WO 2001US31140** 20011003 (PCT/WO US0131140)

Priority Application: **US 2000237916** **20001003**

#### English Abstract

An electronic structure having a first conductive layer provided by a **dual damascene** fabrication process; an etch-stop layer provided by the fabrication process, and electrically coupled with the first conductive layer, the etch-stop layer having a...  
 ...geometry; and a second conductive layer, electrically coupled with the etch-stop layer. The structure can be, for example, a metal-insulator-metal capacitor, an **antifuse**, and the like.

#### Detailed Description

I HIGH-DENSITY METAL CAPACITOR USING

**DUAL-DAMASCENE** COPPER **INTERCONNECT**

BACKGROUND OF THE MENTION

1 Field of the Invention

The invention herein relates to the formation of an integrated circuit including a capacitor.

#### .10 2 Description of the Related Art

Single damascene is an **interconnection** fabrication process in which grooves are formed in an insulating layer and filled with metal, for example, copper, to form the conductive lines. **Dual damascene** is a multi-level **interconnection** process in which conductive **via openings** are formed in addition to forming the grooves of single **damascene**. **Dual damascene** is an improvement over single damascene because it permits the filling of both the conductive grooves and **vias** with metal at the same time, thereby eliminating process steps. Because a **dual damascene** structure satisfies the requirement of low resistance and high electromigration, it has been widely used in deep sub-micron VLSI fabrication processes for obtaining an efficient and reliable **interconnections**. In fabricating very and ultra large scale integration (VLSI and ULSI) circuits with the copper **dual damascene** process, insulating or **dielectric** materials are **patterned** with several thousand **openings** for the conductive lines and **vias**, which are filled at the same time with metal, and serve to **interconnect** the active and/or passive elements of the integrated circuit.

11/3,k/3 (Item 2 from file: 349)  
DIALOG(R) File 349:PCT FULLTEXT  
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00807604 \*\*Image available\*\*

IMPROVED FLOURINE DOPED SIO2 FILM

Patent Applicant/Assignee:

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Patent Applicant/Inventor:

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WILKE Todd, 250 SW 90th Avenue, Portland, OR 97225, US, US (Residence),

BOST Melton, 555 N.E. Joyce Court, Hillsboro, OR 97124-2133, US, US

Patent and Priority Information (Country, Number, Date):

Patent: WO 200141203 A1 20010607 (WO 0141203)

Application: WO 2000US28164 20001011 (PCT/WO US0028164)

Priority Application: US 99451464 19991130

#### Detailed Description

... Flourine doped silicon dioxide (SiO<sub>2</sub>) has been proposed as an intermetal dielectric because of its low dielectric constant and its ease of intregation into current **interconnection** processing.

A current method of forming a flourine doped S'02 layer in order to meet gap fill requirements for sub n-dcron processes is...

...the present invention over the substrate of Figure 1.

Figure 4 is an illustration of a cross-sectional view showing the planarization and formation of **via openings** in the substrate of Figure 3.

Figure 5 is an illustration of a cross-sectional view showing the filling of the **via openings** in the substrate of Figure 4 with a conductive material.

Figure 6 is an illustration of a cross-sectional view showing the formation of a...

...incorporated into the film.

Additionally, since the film can be formed by a high density plasma process it can fill high aspects ratio gaps or **openings**.

The flourine doped nitrogen containing silicon dioxide film of the present invention is ideally suited for use as an intermetal dielectric in the fabrication of...

...device.

The present invention is described with respect to the formation of an intermetal dielectric onto the substrate 100 in order to isolate the metal **interconnect** lines 116 of the first level of metalization (e.g. metal 1) from a ...semiconductor substrates such as those used in the fabrication of memory devices such as DRAMs and EEPROMs or other types of logic devices such as **FPGA's** and ASIC's and can be used on other types of substrates such as those used for flat panel displays. In short the process...

Although one technique for forming **via** as **interconnects** in an on ILD 120 has been described, other well known techniques such as damascene and **dual damascene** can be used if desired. The above described fluorine doped nitrogen containing silicon oxide film formation process and **via/ interconnect** formation process can be continued to provide additional levels of metalization. and isolation as desired.

A method for forming a low dielectric constant silicon dioxide...  
 ...lines 116) and between levels of metalization (e.g., metal 1 and metal 2). The dielectric film 120 can be deposited into high aspect ratio **opening** (aspect ratios as high as 3.5:1).

Additionally, because the film includes a small amount of nitrogen, the film exhibits excellent moisture resistance and...

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 12/3,k/1 (Item 1 from file: 348)  
 DIALOG(R)File 348:EUROPEAN PATENTS  
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01640730

Memory structures

PATENT ASSIGNEE:

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Van Brocklin, Andrew L., 6050 NW Happy Valley Drive, Corvallis, OR 97330,

PATENT (CC, No, Kind, Date): **EP 1351253** A1 031008 (Basic)

APPLICATION (CC, No, Date): EP 2003252043 030331;

PRIORITY (CC, No, Date): **US 115750 020402**

...SPECIFICATION a lesser amount of energy to the memory cell and sensing whether current flows through the cell.

The memory storage element 23 can be an **antifuse** device, such as a programmable tunnel junction device. The **antifuse** device can be either a dielectric rupture type device or a tunnel junction device. The tunnel junction can be formed from oxidized metal, thermally grown...

...and 6 schematically depict an embodiment of a memory structure that includes memory cells each including a memory storage element 23 disposed between a conductive **via** or pillar 233 and an edge of a horizontal conductive plate 239a. A non-horizontal conductive panel 239b is connected to and laterally adjacent the...

...an elongated conductive wall 635 that has a vertical extent and is laterally and laminarly adjacent the non-horizontal conductive panel 639b. A vertical conductive **via** or pillar 641 is disposed in the conductive tub 633 and contacts the tub at an **opening** in the base of the conductive tub, for example. The conductive pillar 641 and the conductive tub 633 form a conductive structure having a vertical...The disclosed memory structures can be implemented using semiconductor equipment. For example, the conductors can be formed by deposition of a metal layer followed by **patterning** by photolithographic masking and

etching. Dielectric regions can be formed by deposition of dielectric material, while oxide layers can be formed by deposition of an...

...or oxidation of a metal feature. Chemical mechanical polishing (CMP) can be employed to planarize and/or expose desired regions. Also, damascene processes such as **dual damascene** can be employed. In **dual damascene** processes, ILD is etched, metal is deposited on the etched ILD, and CMP is performed.

Referring now to FIG. 19, the disclosed structures can generally be made as follows. At 101 a first electrode is created for example by depositing and **patterning** a metal layer. At 103 a control element is formed on the first electrode, for example by oxidizing the electrode or forming an unpatterned oxide layer as described above. At 105 a second electrode having an edge is created, for example by depositing and **patterning** a metal layer. At 107 a memory storage element is formed on the edge of the second electrode, for example by oxidizing the electrode or...

...CLAIMS memory structure of claim 1, 2, 3, 4, 5, 6 or 7 wherein said memory storage element is selected from the group consisting of an **antifuse**, a fuse, a charge storage device, a resistive material, a trap-induced hysteresis material, a ferroelectric capacitor material, a Hall effect material, and a tunneling...

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 11/3,AB,DE/1  
 DIALOG(R) File 350:Derwent WPIX  
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015459456

WPI Acc No: 2003-521598/200349

Related WPI Acc No: 2003-438949

Copper damascene structure formation method, for semiconductor device,  
 involves forming tungsten nitride layer in contact with **opening**  
 formed by directly **patterning low-dielectric** constant layer

Patent Assignee: AHN K Y (AHNK-I); FORBES L (FORB-I)

Inventor: AHN K Y; FORBES L

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 20030020180	A1	20030130	US 2001910914	A	20010724	200349 B

Abstract (Basic):

NOVELTY - A low-dielectric constant layer (55) is directly patterned to form an **opening** in which a copper layer is provided. A tungsten nitride layer is formed in contact with the **opening** by atomic layer deposition using sequential surface reactions.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for:

- (1) the **dual damascene** structure; and
- (2) processor-based system comprising a processor coupled to an integrated circuit, at least one of which contains the damascene structure.

USE - Formation of copper damascene structure in semiconductor devices.

ADVANTAGE - Suppresses diffusion of copper atoms into underlying damascene layers. Sequential photo resist/mask/etch steps and etch-stop layers are eliminated, production costs are reduced and productivity is increased.

DESCRIPTION OF DRAWING(S) - The figure shows a cross sectional view of a semiconductor device.

Copper layer (52)

Dielectric layer (55)

Diffusion barrier layer (72)

pp; 16 DwgNo 17/18

Title Terms: COPPER; STRUCTURE; FORMATION; METHOD; SEMICONDUCTOR; DEVICE;  
 FORMING; TUNGSTEN; NITRIDE; LAYER; CONTACT; **OPEN**; FORMING; PATTERN;  
 LOW; DIELECTRIC; CONSTANT; LAYER

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 11/3,AB,DE/2  
 DIALOG(R) File 350:Derwent WPIX  
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014918916

WPI Acc No: 2002-739623/200280

Electrical metal fuse production comprises forming first **patterned dielectric** layer on substrate, first planarized structure, second **patterned dielectric** layer, and second planarized structure

Patent Assignee: TAIWAN SEMICONDUCTOR MFG CO (TASE-N)

Inventor: YU T

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6444503	B1	20020903	US 200268922	A	20020207	200280 B

Abstract (Basic):

**NOVELTY** - An electrical metal fuse is formed by forming a first **patterned dielectric** layer on a substrate having first **opening(s)**, forming a first planarized structure in the first **opening**, forming a second **patterned dielectric** layer on the planarized structure and having a second **opening**, and forming a second planarized structure in the second **opening**.

**DETAILED DESCRIPTION** - Formation of electrical metal fuse (30) involves forming a first **patterned dielectric** layer (12, 16) on a substrate and having first **opening(s)** exposing at least a portion of the substrate, forming at least a first planarized structure in the first **opening** (18), forming a second **patterned dielectric** layer on the planarized structure and having a second **opening** exposing at least a portion of the first planarized structure, and forming a second planarized structure in the second **opening**. The two planarized structures comprise the electrical metal fuse having a middle portion (34) with a thickness and a width (33, 35) between two end portions (32). The thickness and width of the middle portion is less than that of the end portions.

**USE** - For forming an electrical metal fuse.

**ADVANTAGE** - The process does not require a laser to program the fuses, requires a smaller **space** by the stacking of the end fuse portions to create thicker end fuse portions, and simply produces a more reliable fuse without additional masking. The fuse widths can be reduced due to the stacking of the end fuse portion.

**DESCRIPTION OF DRAWING(S)** - The figures show the process.

Dielectric layer (12, 16)

**Opening** (18)

Metal fuse (30)

End portions (32)

Middle portion (34)

pp; 9 DwgNo 3, 4/12

Title Terms: ELECTRIC; METAL; FUSE; PRODUCE; COMPRISE; FORMING; FIRST; PATTERN; DIELECTRIC; LAYER; SUBSTRATE; FIRST; PLANE; STRUCTURE; SECOND; PATTERN; DIELECTRIC; LAYER; SECOND; PLANE; STRUCTURE

11/3,AB,DE/3  
 DIALOG(R) File 350:Derwent WPIX  
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WPI Acc No: 2002-572764/200261

Fabrication of wire bonds on pure copper damascene for e.g. complementary metal oxide semiconductor devices, involves forming aluminum-copper bond alloy on top of underlying copper pad metal

Patent Assignee: CHARTERED SEMICONDUCTOR MFG LTD PTE (CHAR-N)

Inventor: CHOOI S; HONG S; ZHOU M S

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6376353	B1	20020423	US 2000609167	A	20000703	200261 B

Abstract (Basic):

**NOVELTY** - Wire bonds are fabricated on pure copper damascene by forming aluminum-copper bond alloy on top of underlying copper pad metal.

**DETAILED DESCRIPTION** - Fabrication of wire bonds involves:

- (1) depositing a passivating layer over a first level of conducting wiring (4) defined and over a substrate (1) wafer or module;
- (2) depositing two insulating layers forming intermetal

**dielectric** (IMD) layers, **patterning** and etching the intermetal dielectric layers (14, 16) and passivating layer to form a **dual damascene** trench (20)/**via** (19) **opening** exposing regions of the conducting wiring;

(3) depositing and patterning a cap layer over the second IMD layer;

(4) depositing a first blanket conductive metal barrier layer or first barrier layer over the patterned cap layer and into the trench/**via openings** and over the exposed regions of the conducting wiring;

(5) depositing a blanket copper layer over the first barrier layer and filling the trench/**via opening**;

(6) polishing back by chemical mechanical polishing (CMP) the excess copper and first barrier layer material (13) stopping on the cap layer to form a **dual damascene** inlaid copper in trench/**via opening**;

(7) selectively wet etching the top layer of the inlaid copper to form a recessed copper and partially recessed trench/**via opening**;

(8) etching copper oxide on the top layer of the recessed copper by hydrogen ammonia or ammonia plasma gas treatment;

(9) depositing a second blanket conductive metal barrier layer or second barrier layer (33) over the recessed copper and patterned cap layer;

(10) depositing a blanket layer of aluminum-copper alloy (26, 34) over the second barrier layer and filling partially recessed trench/**via opening**;

(11) annealing thermally with forming gas the alloy; and

(12) polishing back by CMP the alloy and second barrier layer material stopping on the cap layer (17, 27) to form a region of inlaid alloy.

USE - For fabricating wire bonds on pure copper damascene used for metal oxide field effect transistor and complementary metal oxide semiconductor devices and for both memory and logic device applications.

ADVANTAGE - The invention improves wire bond adhesion to the bond pad and prevents peeling during wire bond adhesion tests. It has very low failure rates and shows a high reliability, as tested by gold wire bond pull tests. It is free from stress-attack, corrosion, peeling, interface failure and adhesion failures. The top aluminum-copper bond layer can be soldered without the need for further passivation.

DESCRIPTION OF DRAWING(S) - The figures show cross-sectional views of the invention.

Substrate (1)  
Wiring (4)  
First barrier layer material (13)  
Intermetal dielectric layers (14, 16)  
Cap layer (17, 27)  
**Via** (19)  
trench (20)  
Aluminum-copper alloy (26, 34)  
Second barrier layer (33)  
pp; 18 DwgNo 3d, 4d/5

Title Terms: FABRICATE; WIRE; BOND; PURE; COPPER; COMPLEMENTARY; METAL; OXIDE; SEMICONDUCTOR; DEVICE; FORMING; ALUMINIUM; COPPER; BOND; ALLOY; TOP; UNDERLYING; COPPER; PAD; METAL

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 11/3,AB,DE/4  
 DIALOG(R) File 350:Derwent WPIX  
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014572174

WPI Acc No: 2002-392878/200242

Reduction of etching of seed layer by plating solution, comprises  
 diminishing etching power of plating solution prior to exposing seed  
 layer to plating solution and initiating plating current

Patent Assignee: ANDRICACOS P C (ANDR-I); HORKANS W J (HORK-I); KWIETNIAK K  
 T (KWIE-I); LOCKE P S (LOCK-I); UZOH C E (UZOH-I)

Inventor: ANDRICACOS P C; HORKANS W J; KWIETNIAK K T; LOCKE P S; UZOH C E

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 20020027082	A1	20020307	US 99387856	A	19990901	200242 B
			US 2001983235	A	20011023	

Abstract (Basic):

NOVELTY - Reduction of etching of a seed layer by a plating  
 solution, comprises diminishing an etching power of the plating  
 solution prior to exposing the seed layer to the plating solution and  
 initiating a plating current.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for the  
 following:

(A) a method of electroplating **interconnecting** structures on  
 a semiconductor wafer comprising depositing a layer of dielectric  
 material on a surface of a semiconductor wafer comprising integrated  
 circuits; **patterning** the layer of **dielectric** material  
 exposing a portion of the semiconductor wafer, the patterning matching  
 a desired pattern of **interconnect** structures to be deposited on  
 the semiconductor wafer; depositing a layer of a barrier material over  
 the **patterned** layer of **dielectric** material; depositing an  
 electrically conducting seed layer on the layer of barrier material;  
 introducing the wafer into a plating solution; diminishing an etching  
 power of the plating solution; initiating a plating current to  
 electrodeposit at least one metal over the entire surface of the seed  
 layer; and removing an overburden of electroplating metal and the seed  
 layer and barrier layer lying on top of the layer of dielectric  
 material;

(B) a deaerated plating solution comprising at least one metal to  
 be plated on a seed layer; at least one acid; and a level of dissolved  
 oxygen less than 10 to the power -7 to 5 x 10 to the power -6  
 moles/liter; and

(C) a plating tool comprising a plating cell (2); a plating  
 solution reservoir (1); supply line (3) for feeding plating solution  
 from the plating solution reservoir to the plating cell; return line  
 (4) for feeding plating solution from the plating cell to the plating  
 solution reservoir; and an inert gas supply for introducing inert gas  
 into the plating solution.

USE - The method is used for reducing etching of a seed layer by a  
 plating solution. It is favorable for use in electroplating of copper  
 in back end of line (BEOL) structures, and may be used in any metal  
 plating operation. It is particularly useful for use in applications  
 where copper **interconnections** are to be deposited by  
 electroplating on a seed layer on a semiconductor wafer including  
 integrated circuits.

ADVANTAGE - The method improves the reliability of electrical

contact to a seed layer for plating and protecting the electrical contact to the seed layer. It can minimize chemical attack on seed layers, particularly in metal lines and trenches that can occur in the plating bath before the current is engaged. It prevents dissolution of conducting seed layer that can occur in the vicinity of the electrical contacts to a semiconductor wafer surface. It permits use of very thin seed layers in the damascene fabrication techniques for on-chip **interconnections** using electroplated copper. It protects very thin current-carrying layers from attack by the plating solution in the period before the plating current is applied.

DESCRIPTION OF DRAWING(S) - The figure represents a schematic drawing illustrating a plating system including elements for eliminating dissolved oxygen from a plating bath.

Reservoir (1)  
Plating cell (2)  
Supply line (3)  
Return line (4)  
pp; 8 DwgNo 2/2

Title Terms: REDUCE; ETCH; SEED; LAYER; PLATE; SOLUTION; COMPRISE; DIMINISH  
; ETCH; POWER; PLATE; SOLUTION; PRIOR; EXPOSE; SEED; LAYER; PLATE;  
SOLUTION; INITIATE; PLATE; CURRENT

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11/3,AB,DE/5  
DIALOG(R)File 350:Derwent WPIX  
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WPI Acc No: 2002-289562/200233

Method of forming conductive lines of semiconductor device  
Patent Assignee: HYNIX SEMICONDUCTOR INC (HYNI-N)  
Inventor: KIM J H

Patent No	Kind	Date	Applicat No	Kind	Date	Week
KR 2001061124	A	20010707	KR 9963610	A	19991228	200233 B

Priority Applications (No Type Date): KR 9963610 A 19991228

Abstract (Basic):

NOVELTY - A conductive line forming method for semiconductor device is provided to enhance the features and reliability of a semiconductor device by forming a conductive lines using a **dual damascene** technique for avoiding dishing or erosion.

DETAILED DESCRIPTION - A semiconductor substrate(21) is provided with an **oxide film line/space pattern**. A tungsten film(23) is formed on the whole surface of the semiconductor substrate(21) to fill between the line/**space** pattern. The tungsten film(23) is flattened through Chemical Mechanical Polishing (CMP) using slurry. The slurry has a ratio to deionized water of 100 to 500 : 1, or to a hydrogen peroxide of 50 to 100 : 1, and pH of 2 to 4. KOH or NH4OH is added to the slurry to prevent agglomeration of polishing particles.

pp; 1 DwgNo 1/10

Title Terms: METHOD; FORMING; CONDUCTING; LINE; SEMICONDUCTOR; DEVICE

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11/3,AB,DE/7  
DIALOG(R)File 350:Derwent WPIX  
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WPI Acc No: 2001-540102/200160

Method for manufacturing **dual damascene** structure comprises forming trench, forming cavity under trench, forming **opening** under cavity, forming metal layer on second dielectric and filling trench, cavity and **opening**

Patent Assignee: UNITED MICROELECTRONICS CORP (UNMI-N)

Inventor: LAI Y

Patent No	Kind	Date	Applicat No	Kind	Date	Week
<b>TW 429572</b>	<b>A</b>	<b>20010411</b>	TW 99113863	<b>A</b>	19990813	200160 <b>B</b>

Abstract (Basic):

NOVELTY - Method for manufacturing **dual damascene** structure comprises: forming trench through second dielectric and mask to expose first **dielectric**; forming **patterned** photoresist on second **dielectric**; etching to form a cavity under trench in the first dielectric; etching first dielectric to form an **opening** under cavity; forming metal layer on second dielectric; and filling trench, cavity and **opening**.

DETAILED DESCRIPTION - Method for manufacturing **dual damascene** structure comprises:

- (a) sequentially forming a first dielectric, a mask and a second dielectric on substrate;
- (b) removing part of the second dielectric and part of the mask until surface of the first dielectric is exposed to form a trench;
- (c) forming a patterned photoresist layer on the second dielectric;
- (d) conducting isotropic etching to form a cavity under the trench in the first dielectric in which the width of the cavity is smaller than the width of the trench;
- (e) conducting anisotropic etching to etch the first dielectric to form an **opening** under the cavity; and
- (f) after removing the photoresist, forming a metal layer on the second dielectric and filling up the trench, the cavity and the **opening**.

USE - None given.

ADVANTAGE - Generation of voids is decreased in order to increase the reliability of the **dual damascene** structure.

DwgNo 0/1

Title Terms: METHOD; MANUFACTURE; DUAL; STRUCTURE; COMPRISE; FORMING; TRENCH; FORMING; CAVITY; TRENCH; FORMING; **OPEN**; CAVITY; FORMING; METAL; LAYER; SECOND; DIELECTRIC; FILL; TRENCH; CAVITY; **OPEN**

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11/3,AB,DE/8

DIALOG(R)File 350:Derwent WPIX

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WPI Acc No: 2001-535007/200159

Fabrication of **dual damascene** structures useful in, e.g., integrated circuit microelectronic fabrications, involves employing spin-on polymer etch stop layer

Patent Assignee: TAIWAN SEMICONDUCTOR MFG CO (TASE-N)

Inventor: JANG S

Patent No	Kind	Date	Applicat No	Kind	Date	Week
<b>US 6265319</b>	<b>B1</b>	<b>20010724</b>	<b>US 99387440</b>	<b>A</b>	<b>19990901</b>	<b>200159 <b>B</b></b>

Abstract (Basic):

NOVELTY - A **dual damascene** structure is fabricated by

employing spin-on polymer etch stop layer.

**DETAILED DESCRIPTION** - Formation of a **dual damascene** structure comprises (a) forming a first dielectric layer (14') over a substrate (10) having contact regions (12a-c); (b) forming an intermediate carbon-containing low dielectric constant dielectric layer (16'), upon the first dielectric layer; (c) forming a second dielectric layer (18'), upon the intermediate dielectric layer; (d) forming a first patterned photoresist etching mask layer which defined contact **via** holes, over the second dielectric layer; (e) etching through the first patterned photoresist mask layer employing a first anisotropic reactive etch process, and transferring the pattern into and through the second dielectric layer, intermediate dielectric constant dielectric layer, and first dielectric layer; (f) stripping the first patterned photoresist etch mask layer; (g) forming a second patterned photoresist etch mask layer defining a trench pattern, over the substrate; (h) etching through the second patterned photoresist etch mask layer employing a second anisotropic reactive etch process, and transferring the trench **pattern** into the second **dielectric** layer, using the intermediate dielectric layer as an etch stop layer, thus forming an etched contact **via** hole and trench pattern; and (i) stripping the second patterned photoresist etch mask layer.

**USE** - For forming **dual damascene** structures, i.e., metal **interconnection** layers useful in microelectronic fabrications, such as, integrated circuit microelectronic fabrications, charge coupled device microelectronic fabrications, light emitting diode microelectronic fabrications, and flat panel display microelectronic fabrications (claimed).

**ADVANTAGE** - The invention provides a **dual damascene** stacked conductor **interconnection** layer with reduced inter-level capacitance and lowered electrical resistance.

**DESCRIPTION OF DRAWING(S)** - The figure shows a cross-sectional schematic view of the **dual damascene** structure.

Substrate (10)  
Contact regions (12a-c)  
First dielectric layer (14')  
Intermediate dielectric layer (16')  
Second dielectric layer (18')  
Conductor material (28)  
**Dual damascene interconnection** layer (29)  
pp; 13 DwgNo 4/12

Title Terms: FABRICATE; DUAL; STRUCTURE; USEFUL; INTEGRATE; CIRCUIT;  
MICROELECTRONIC; FABRICATE; EMPLOY; SPIN; POLYMER; ETCH; STOP; LAYER

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11/3,AB,DE/9

DIALOG(R)File 350:Derwent WPIX

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WPI Acc No: 2001-334459/200135

**Dual-damascene** process involves forming first **dielectric** layer, stop layer **pattern** and second **dielectric** layer on wafer, etching these layers to form **via**, forming conductor on wafer and chemical mechanical polishing to form conductive wires

Patent Assignee: IND TECHNOLOGY RES INST (INTE-N)

Patent No	Kind	Date	Applicat No	Kind	Date	Week
<b>TW 417248</b>	<b>A</b>	<b>20010101</b>	TW 99120383	A	19991118	200135 B

Title Terms: DUAL; PROCESS; FORMING; FIRST; DIELECTRIC; LAYER; STOP; LAYER; PATTERN; SECOND; DIELECTRIC; LAYER; WAFER; ETCH; LAYER; FORM; FORMING; CONDUCTOR; WAFER; CHEMICAL; MECHANICAL; POLISH; FORM; CONDUCTING; WIRE

11/3, AB, DE/10

DIALOG(R) File 350:Derwent WPIX

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WPI Acc No: 2001-315694/200133

Deposition of copper seed layer involves providing dielectric layer overlying semiconductor substrate, **patterning dielectric** layer, depositing barrier and copper seed layers, and performing electroless plating

Patent Assignee: CHARTERED SEMICONDUCTOR MFG LTD PTE (CHAR-N)

Inventor: GUPTA S; KEUNG P H K; RAMASAMY C; SHENG Z M; HO P K K; ZHOU M S

Patent No	Kind	Date	Applicat No	Kind	Date	Week	
<b>US 6225221</b>	<b>B1</b>	<b>20010501</b>	<b>US 2000501966</b>	<b>A</b>	<b>20000210</b>	<b>200133</b>	<b>B</b>
SG 93880	A1	20030121	SG 20004601	A	20000817	200319	

## Abstract (Basic):

NOVELTY - A copper seed layer is deposited by providing dielectric layer overlying a semiconductor substrate; **patterning** the **dielectric** layer to form trenches; depositing barrier layer overlying the dielectric layer; depositing a copper seed layer overlying the barrier layer; and performing electroless plating using copper seed layer to complete the integrated circuit (IC) device.

DETAILED DESCRIPTION - Deposition of a copper (Cu) seed layer (38) comprises:

- (i) providing a dielectric layer (30) overlying a semiconductor substrate (28);
- (ii) **patterning** the **dielectric** layer to form trenches for planned **dual damascene interconnects**;
- (iii) depositing a barrier layer (34) overlying the dielectric layer;
- (iv) depositing a Cu seed layer overlying the barrier layer by the reaction of copper (II) fluoride gas with the barrier layer; and
- (v) performing electroless plating using Cu seed layer to complete the IC device.

USE - For depositing a Cu seed layer for electroless Cu plating in the fabrication of **dual damascene interconnects** for the manufacture of IC devices.

ADVANTAGE - The method deposits a Cu seed layer more conformally than physical vapor deposition. It does not require expensive precursors, it is faster and cleaner than electroless plating, and does not require induction layers to plate. The seed layer can be kept very thin while still covering the steps.

DESCRIPTION OF DRAWING(S) - The figure schematically illustrates a cross-section of IC device.

Semiconductor substrate (28)  
Dielectric layer (30)  
Barrier layer (34)  
Cu seed layer (38)  
pp; 8 DwgNo 3/5

Title Terms: DEPOSIT; COPPER; SEED; LAYER; DIELECTRIC; LAYER; OVERLIE;  
SEMICONDUCTOR; SUBSTRATE; PATTERN; DIELECTRIC; LAYER; DEPOSIT; BARRIER;  
COPPER; SEED; LAYER; PERFORMANCE; ELECTROLESS; PLATE

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11/3,AB,DE/11  
DIALOG(R)File 350:Derwent WPIX  
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WPI Acc No: 2001-257003/200126

**Dual damascene copper interconnect** formed by depositing copper on barrier layer formed over metal layer with **via pattern** formed in **dielectric** using SiN as etch stop

Patent Assignee: TAIWAN SEMICONDUCTOR CO (TASE-N)

Inventor: LIU C

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6211085	B1	20010403	US 99252491	A	19990218	200126 B

## Abstract (Basic):

NOVELTY - **Dual damascene copper interconnect** is formed by depositing dielectric and then a SiN layer by PE-CVD. A **via** pattern is formed by etching through the second dielectric layer and a conducting line pattern is formed using SiN as etch stop.

Metal layer (80), barrier (90) and copper seed barrier are deposited. Copper (94) is deposited by electroplating and then planarized. Thickness of second dielectric layer is greater than first.

USE - Formation of **interconnect** of semiconductor device.

ADVANTAGE - The method does not involve CVD of tungsten at the contact level and does not require CMP.

DESCRIPTION OF DRAWING(S) - The figure shows three process steps.

Metal (80)

Barrier (90)

Copper (94)

pp; 8 DwgNo 4,5,6/6

Title Terms: DUAL; COPPER; **INTERCONNECT**; FORMING; DEPOSIT; COPPER;

BARRIER; LAYER; FORMING; METAL; LAYER; PATTERN; FORMING; DIELECTRIC; ETCH  
; STOP

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11/3,AB,DE/12

DIALOG(R)File 350:Derwent WPIX

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WPI Acc No: 2001-256681/200126 Related WPI Acc No: 1999-468454

Formation of contact level **dual damascene** on silicon

substrate uses titanium aluminum nitride barrier layer, and aluminum wetting layer between the barrier layer and copper layer

Patent Assignee: MICRON TECHNOLOGY INC (MICR-N)

Inventor: MCTEER A

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6204179	B1	20010320	US 9838221	A	19980311	200126 B

Cont of patent US 5939788

Abstract (Basic):

NOVELTY - A contact level **dual damascene** is formed on a silicon substrate (10) by providing two insulating layers (7, 9) on the substrate with an **opening**, depositing a refractory metal layer on inside surfaces of the **opening**, depositing a barrier layer (4) on the metal layer, depositing a wetting layer on the barrier layer, and depositing a copper layer (3) on the wetting layer to fill the **opening**.

USE - For forming a contact level **dual damascene** on a silicon substrate useful in very large-scale integrated circuit.

ADVANTAGE - The invention provides a barrier layer that is stable to high temperatures required to reflow copper after physical vapor deposition, and an aluminum wetting layer that effectively lowers the temperature at which the copper reflows and allows the use of typical barrier layers.

DESCRIPTION OF DRAWING(S) - The figure shows a cross-section of a contact level **dual damascene**.

Copper layer (3)

Barrier layer (4)

Copper aluminum alloy (6)

Insulating layers (7, 9)

Silicon substrate (10)

Refractory metal silicide (11)

Refractory metal layer (13)

pp; 23 DwgNo 6/16

Title Terms: FORMATION; CONTACT; LEVEL; DUAL; SILICON; SUBSTRATE; TITANIUM; NITRIDE; BARRIER; LAYER; WET; LAYER; BARRIER; LAYER; COPPER; LAYER

11/3,AB,DE/13  
 DIALOG(R)File 350:Derwent WPIX  
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WPI Acc No: 2001-181864/200118

Creation of a copper **dual damascene** structure comprises forming copper seed layer inside **opening** and over intermetal dielectric, filling **opening** with spin-on material, and removing seed layer over dielectric

Patent Assignee: CHARTERED SEMICONDUCTOR MFG PTE LTD (CHAR-N); CHARTERED SEMICONDUCTOR MFG LTD PTE (CHAR-N); CHARTERED SEMICONDUCTOR MFG LTD

Inventor: GUPTA S; KWOK KEUNG HO P; SHENG ZHOU M; HO P K K; ZHOU M S

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6184138	B1	20010206	US 99390782	A	19990907	200118 B

Abstract (Basic):

NOVELTY - Creation of a copper **dual damascene** structure comprises forming a copper seed layer inside **dual damascene opening** and over surface of inter-metal dielectric (IMD), filling **opening** with spin-on material, removing the seed layer above the IMD, removing the spin-on material, and electrolessly depositing copper layer over the **opening**.

DETAILED DESCRIPTION - Creation of a copper **dual damascene** structure on the surface of a semiconductor substrate comprises forming an **opening** for a **dual damascene** structure on the surface of the substrate in a layer of inter-metal dielectric (IMD) (16) over which a cap layer (18) has been deposited. The surface of the substrate contains metal contact points. A diffusion barrier layer (20) is deposited inside the **opening** and over the surface of the surrounding area. A copper seed layer (26) is deposited over the diffusion barrier layer. A spin-on layer is deposited over the copper seed layer. The spin-on material is removed from above the **opening** and from above the surface of the surrounding area. The spin-on material is left in place inside the **opening** of the **dual damascene** structure. The copper seed layer and barrier layer are each removed from above the surface of the surrounding area. The spin-on material is removed from the **opening** of the **dual damascene** structure. A layer of copper is selectively electroless deposited over the **dual damascene opening**. The excess copper is removed from above the **dual damascene opening** by a touch-up chemical-mechanical polishing (CMP). An oxidation/diffusion protection layer (30) is deposited over the surface of the **dual damascene** structure and its surrounding area.

USE - For creating a copper **dual damascene** structure on the surface of a semiconductor substrate.

ADVANTAGE - The method reduces surface dishing and erosion in the copper surface of a **dual damascene** structure and improves global planarity and uniformity of the copper surfaces of **dual damascene** structures.

DESCRIPTION OF DRAWING(S) - The drawings show cross-sections of a copper **dual damascene** structure, at different process stages.

IMD layer (16)

cap layer (18)  
 barrier layer (20)  
 copper seed layer (26)  
 oxidation/diffusion protection layer (30)  
 pp; 9 DwgNo 5,6,7/7

Title Terms: CREATION; COPPER; DUAL; STRUCTURE; COMPRISE; FORMING; COPPER;  
 SEED; LAYER; **OPEN**; DIELECTRIC; FILL; **OPEN**; SPIN; MATERIAL;  
 REMOVE; SEED; LAYER; DIELECTRIC

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 11/3,AB,DE/14  
 DIALOG(R)File 350:Derwent WPIX  
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WPI Acc No: 2001-137245/200114 Related WPI Acc No: 1999-619684

Formation of **dual damascene** pattern used in integrated chip  
 manufacture involves providing substrate having composite insulation  
 layer, patterning a photoresist layer using phase-shift mask, and  
 depositing metal into the trench and the hole

Patent Assignee: IND TECHNOLOGY RES INST (INTE-N)

Inventor: DAI C

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6180512	B1	20010130	US 97949353	A	19971014	200114 B
			US 99359903	A	19990726	

Abstract (Basic):

NOVELTY - A **dual damascene** pattern is formed by  
 providing a substrate with deposited composite insulation layer;  
 patterning the photoresist layer using a phase-shifting mask; forming a  
 patterned photoresist layer; performing wet development; transferring  
 the hole pattern and the line **pattern** into the **dielectric**  
 layer; removing the photoresist layer; and depositing metal into trench  
 and hole.

DETAILED DESCRIPTION - Formation of a **dual damascene**  
 pattern employing single photoresist layer comprises: providing a  
 substrate (150) with deposited composite insulation layer comprising  
 two dielectric layers (160, 180); forming a photoresist layer on the  
 composite layer; patterning the photoresist layer by exposing it using  
 a phase-shifting mask comprising hole and line patterns and followed by  
 baking; performing a wet development to form a patterned photoresist  
 layer; etching the second layer of the dielectric using the photoresist  
 layer as mask thus transferring the hole **pattern** into the  
 intermediate **dielectric** layer (170); etching photoresist to  
 extend downward; etching the composite insulation layer thus  
 transferring the line **pattern** into the second **dielectric**  
 layer to form a line trench, and transferring the hole pattern in to  
 the first dielectric layer to form a hole; removing the photoresist  
 layer; and depositing metal (200, 210) into the trench and the hole to  
 form a **dual damascene** structure.

USE - The method is used for forming **dual damascene**  
 patterns or for the fabrication of metal lines and **vias** in a  
 semiconductor substrate. The method is used for formation of ultra  
 large scale (ULSI) integrated chips.

ADVANTAGE - The method is simple and improves the alignment of  
 wiring layer to the underlying **interconnect** hole pattern. It  
 reduces overlay tolerances and process bias thus increases the packing  
 density of ultra large scaled integrated chips.

DESCRIPTION OF DRAWING(S) - The figure is a partial cross-sectional view of a semiconductor substrate with metal deposited in the trench and in the hole.

Substrate (150)

Dielectric layers (160, 170, 180)

Metal (200, 210)

pp; 12 DwgNo 4h/4

Title Terms: FORMATION; DUAL; PATTERN; INTEGRATE; CHIP; MANUFACTURE;  
SUBSTRATE; COMPOSITE; INSULATE; LAYER; PATTERN; PHOTORESIST; LAYER; PHASE  
; SHIFT; MASK; DEPOSIT; METAL; TRENCH; HOLE

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11/3, AB, DE/15

DIALOG(R) File 350:Derwent WPIX

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WPI Acc No: 2000-678770/200066

Related WPI Acc No: 2001-266387; 2001-397185; 2003-635865

Seed layers for semiconductor **interconnects** for thin head films or micromachined Microelectromechanical Systems devices

Patent Assignee: COHEN U (COHE-I)

Inventor: COHEN U

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6136707	A	20001024	US 99410898	A	19991002	200066 B

Abstract (Basic):

NOVELTY - Electroplating metals or alloys for filling high aspect ratio **openings** e.g trenches and **vias**, for semiconductor metallisation **interconnects**, thin film heads, or micromachined Microelectromechanical Systems devices.

DETAILED DESCRIPTION - Production of metallic **interconnects** comprises:

- (1) forming a **patterned insulating** layer on a substrate, the **patterned insulating** layer including at least one **opening** with a surrounding field;
- (2) depositing a barrier layer over the field and inside surfaces of the **opening(s)**;
- (3) depositing a first seed layer over the barrier layer using first deposition technique;
- (4) depositing a second seed layer over the first using second deposition technique;
- (5) electroplating a metallic layer over the second seed layer, comprising copper, silver, or alloy containing one of these metals.

USE - Electroplating of trenches or **vias** for semiconductor **interconnects**.

ADVANTAGE - The improved seed layers provide reliable void-free filling of small **openings** with high aspect ratios for (Dual ) **Damascene** copper and/or silver **interconnects**.

DESCRIPTION OF DRAWING(S) - Cross-sectional view of structure.

barrier layer (18)

wafer surface (10)

**patterned insulation** layer (12)

**opening** (16)

conformal seed layer (20)

non-conformal seed layer (22)

**interconnect** (24)

pp; 9 DwgNo 2/4

Title Terms: SEED; LAYER; SEMICONDUCTOR; **INTERCONNECT**; THIN; HEAD;  
FILM; SYSTEM; DEVICE

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11/3,AB,DE/16  
DIALOG(R) File 350:Derwent WPIX  
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WPI Acc No: 2000-586367/200055

Formation of damascene structures used in ultra large scale integrated circuit chips involves forming a seed layer via tungsten chemical vapor deposition process

Patent Assignee: IND TECHNOLOGY RES INST (INTE-N)

Inventor: CHEN H; LOU C

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6110826	A	20000829	US 9892816	A	19980608	200055 B

#### Abstract (Basic):

NOVELTY - **Dual damascene** structure is formed by forming a seed layer in a selected portion of a structure via selective tungsten chemical vapor deposition.

DETAILED DESCRIPTION - Formation of a **dual damascene** structure using selective tungsten chemical vapor deposition (W CVD) comprises:

- (a) forming an interlevel dielectric (ILD) layer (600) over a semiconductor substrate (100) having active and passive regions;
- (b) forming an etch-stop layer (650) over the ILD layer and an intermetal dielectric (IMD) layer (700) over the etch-stop layer;
- (c) forming a first photoresist layer over the IMD layer and patterning with a mask containing a line trench pattern;
- (d) etching through the line trench pattern to form the line trench pattern into the IMD layer and then removing the first photoresist layer;
- (e) forming a seed layer (800) over the IMD layer including the line trench (725) with sidewall (850) and flat bottom (875);
- (f) removing the seed layer from the surface of the IMD layer;
- (g) forming a second photoresist over the IMD layer and the line trench and patterning with a mask having a contact hole pattern;
- (h) etching through the contact hole pattern to form the contact hole **pattern** into the **ILD** layer;
- (i) removing the second photoresist layer and cleaning the contact hole;
- (j) depositing a selective W CVD in the line trench and contact hole composite structure; and
- (k) performing chemical mechanical polish to planarize and to complete the fabrication of the semiconductor substrate.

USE - For forming **dual damascene** structure useful in ultra large scale integrated circuit chips.

ADVANTAGE - Provides contact holes and **via** holes with free voids.

DESCRIPTION OF DRAWING(S) - The drawing shows a **dual damascene** structure.

semiconductor substrate (100)  
ILD layer (600)  
etch-stop layer (650)  
IMD layer (700)  
pp; 11 DwgNo 4f/4

Title Terms: FORMATION; STRUCTURE; ULTRA; SCALE; INTEGRATE; CIRCUIT; CHIP;  
FORMING; SEED; LAYER; TUNGSTEN; CHEMICAL; DEPOSIT; PROCESS

11/3,AB,DE/17  
DIALOG(R) File 350:Derwent WPIX  
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WPI Acc No: 2000-422094/200036

Fabrication of metal line using deposition process involves providing  
**insulating** layer with trenches, **patterning** a seed layer,  
depositing a metal, and chemical-mechanical polishing  
Patent Assignee: TAIWAN SEMICONDUCTOR MFG CO (TASE-N)

Inventor: JANG S

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6071814	A	20000606	US 98161566	A	19980928	200036 B

Abstract (Basic):

NOVELTY - Metal line is fabricated by providing an insulating layer with trenches defined by sidewalls and a bottom, patterning a seed layer to form a seed layer lip, depositing metal, and chemical-mechanical polishing the metal and seed layer lip.

DETAILED DESCRIPTION - A metal line (50) is fabricated by:  
providing an insulating layer (20) having trenches (24) arranged in a pattern where each trenches is defined by sidewalls and a bottom; forming a seed layer (30B) over the insulating layer, sidewalls, and the bottom of each trench;

patterning a top seed layer portion by removing portions of the seed layer to form seed layer lips (30C) adjacent a trench seed layer portion so that the remaining seed layer electrically connects the trench seed layers in the trenches;

depositing a metal on the top seed layer, the seed layer lips, and the trench seed layer portion filling the trenches; and

chemical-mechanically polishing the metal and the seed layer lips to remove excess metal and the seed layer lips and forming a metal line pattern filling the trenches.

The seed layer comprises trench seed layer portion covering the sidewalls and bottoms of the trenches. The top seed layer portion covers the insulating layer top surfaces.

USE - For fabricating a metal line using deposition process.

ADVANTAGE - The invention is faster and easier because the field areas are not covered with metal. The remaining metal on the insulating layer can be polished off faster and eliminates dishing.

DESCRIPTION OF DRAWING(S) - The figure shows a cross-sectional view of forming and patterning a seed layer.

Insulating layer (20)

Trench (24)

Seed layer (30B)

Seed layer lips (30C)

Metal line (50)

pp; 8 DwgNo 4/6

Title Terms: FABRICATE; METAL; LINE; DEPOSIT; PROCESS; INSULATE; LAYER;  
TRENCH; PATTERN; SEED; LAYER; DEPOSIT; METAL; CHEMICAL; MECHANICAL;  
POLISH

11/3,AB,DE/18  
DIALOG(R) File 350:Derwent WPIX

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012901130

WPI Acc No: 2000-072966/200006

Forming an **interconnect** structure for an integrated circuit device  
Patent Assignee: CONEXANT SYSTEMS INC (CONE-N); NEWPORT FAB LLC (NEWP-N)

Inventor: BRONGO M R; ZHAO B

Patent No	Kind	Date	Applicat No	Kind	Date	Week
WO 9963591	A1	19991209	WO 99US11410	A	19990526	200006 B
EP 1080495	A1	20010307	EP 99924469	A	19990526	200114
US 6627539	B1	20030930	US 9887116	P	19980529	200367
			US 98149910	A	19980909	

Abstract (Basic):

NOVELTY - An **interconnect** structure for an integrated circuit device is formed using two low-k dielectric layers with no chemical-mechanical polishing.

DETAILED DESCRIPTION - The method comprises: forming a planar layer of conductor and gap-fill dielectric; adding layers of, in sequence, first low-k dielectric, first cap dielectric, second low-k dielectric and second cap **dielectric**; **patterning** the layers into **vias** and in the first low-k dielectric layer and trenches in the second low-k dielectric layer, the first cap dielectric layer acting as an etch buffer; adding a conformal metal layer which contacts the conductor; and removing excess metal to form a planar surface.

USE - Forming an **interconnect** structure for an integrated circuit device.

ADVANTAGE - A **dual damascene** process is provided which is simple and low cost and which avoids chemical-mechanical polishing and reduces parasitic capacitance and coupling.

pp; 26 DwgNo 0/3

Title Terms: FORMING; **INTERCONNECT**; STRUCTURE; INTEGRATE; CIRCUIT; DEVICE

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11/3, AB, DE/19

DIALOG(R) File 350:Derwent WPIX

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013539090

WPI Acc No: 2001-023296/200103 Related WPI Acc No: 2002-266554

**Dual damascene** process involves depositing second silicon nitride layer on exposed wiring layer, depositing barrier layer on **via** hole and trench, and over-filling the **via** hole and the trench with copper

Patent Assignee: IND TECHNOLOGY INST RES (INTE-N)

Inventor: LIN K

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6140220	A	20001031	US 99349843	A	19990708	200103 B

Abstract (Basic):

NOVELTY - A **dual damascene** process comprises depositing a second silicon nitride layer on an exposed wiring layer. A barrier layer is deposited covering the interior surfaces of a **via** hole and a trench. The **via** hole and the trench are over-filled with copper. The copper layer is planarized in which the trench is just filled with copper and the third silicon oxide layer is exposed.

DETAILED DESCRIPTION - A **dual damascene** process

comprises providing a partially completed integrated circuit covered by a first silicon oxide layer (11) in which a first damascene wiring layer (12) is embedded in its upper surface. A first silicon nitride layer (13) is deposited on the upper layer of the wiring, and a second silicon oxide layer (21) on the first silicon nitride layer. The second silicon **oxide layer** is **patterned** and etched to form a **via** hole (61) that extends through the first silicon nitride layer, exposing the first layer of damascene wiring. A conformal layer of second silicon nitride is deposited on the exposed wiring layer, forming a coating on all interior surfaces of the **via** hole and on the second silicon oxide layer. The coated **via** hole is over-filled with silicon oxide which forms a third silicon layer on the second silicon nitride layer. The third silicon **oxide layer** is **patterned** and etched with an etchant that attacks both silicon oxide and silicon nitride with an etching ratio of 6:1 to 15:1, oxide:nitride. A trench in the third silicon oxide layer is formed, which fully overlaps the **via** hole extending through the second silicon nitride layer to the second silicon oxide layer, and exposing the first layer of damascene wiring. A barrier layer is deposited to form a coating that covers all the interior surfaces of the **via** hole and of the trench, as well as the exposed first wiring layer, and that covers the third silicon oxide layer. The **via** hole and the trench are over-filled with copper. The copper layer is planarized in which the trench is just filled with copper and the third silicon oxide layer is exposed.

USE - For forming **dual damascene** structures.

ADVANTAGE - The invention allows the use of a barrier layer that is thinner than normal so that more copper can be included in the **via** hole, resulting in an improved conductance of the **via**.

DESCRIPTION OF DRAWING(S) - The figure illustrates the formation of a **via** hole portion of a **dual damascene** structure.

first silicon oxide layer (11)  
first damascene wiring layer (12)  
first silicon nitride layer (13)  
second silicon oxide layer (21)  
**via** hole (61)

pp; 9 DwgNo 6/12

Title Terms: DUAL; PROCESS; DEPOSIT; SECOND; SILICON; NITRIDE; LAYER;  
EXPOSE; WIRE; LAYER; DEPOSIT; BARRIER; LAYER; HOLE; TRENCH; FILL; HOLE;  
TRENCH; COPPER

L9 ANSWER 1 OF 3 HCAPLUS COPYRIGHT 2004 ACS on STN  
 AN 2002:575481 HCAPLUS Full-text  
 TI Metal-to-metal **antifuse** structure and fabrication method  
 IN Wang, Daniel C.  
 PA Actel Corporation, USA

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI US 2002100907	A1	20020801	US 2000-737642	20001214 <b>X</b>
			US 2000-737642 A	20001214
			WO 2001-US49300W	20011213

AB A metal-to-metal **antifuse** according to the present invention is compatible with a Cu **dual damascene** process and is formed over a lower Cu metal layer planarized with the top surface of a lower insulating layer. A lower barrier layer is disposed over the lower Cu metal layer. An **antifuse** material layer is disposed over the lower barrier layer. An upper barrier layer is disposed over the **antifuse** material layer. An upper insulating layer is disposed over the upper barrier layer. An upper Cu metal layer is planarized with the top surface of the upper insulating layer and extends to make elec. contact with the upper barrier layer.

ST copper **antifuse** semiconductor integrated circuit

IT Polishing

(chemical-mech.; metal-to-metal **antifuse** in semiconductor integrated circuit device)

IT **Antifuses**

Electric contacts

Integrated circuits

**Interconnections**, electric

(metal-to-metal **antifuse** in semiconductor integrated circuit device)

IT 409-21-2, Silicon carbide, processes 7440-21-3, Silicon, processes 7440-50-8, Copper, processes 7631-86-9, Silica, processes 11116-16-8, Titanium nitride 12033-62-4, Tantalum nitride 12033-89-5, Silicon nitride, processes

RL: DEV (Device component use); EPR (Engineering process); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)

(metal-to-metal **antifuse** in semiconductor integrated circuit device)

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L9 ANSWER 2 OF 3 HCAPLUS COPYRIGHT 2004 ACS on STN  
 AN 2002:256715 HCAPLUS Full-text  
 TI High density metal/insulator/metal capacitor using **dual-damascene** copper **interconnect** and fabrication for integrated circuits

IN Tsau, Liming

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI US 2002038903	A1	20020404	US 2001-971254	20011003
			US 2000-237916PP	20001003 <b>X</b>
WO 2002029892	A3	20030306	WO 2001-US31140	20011003

AB A method is claimed for fabricating a MIM capacitor with fewer steps using standard materials. An electronic structure having a 1st conductive layer provided by a **dual damascene** fabrication process; an etch-stop layer provided by the fabrication process, and elec. coupled with the 1st conductive layer, the etch-stop layer having a preselected dielec. constant and a predetd. geometry; and a 2nd conductive layer, elec. coupled with the etch-stop layer. The structure can be, for example, a metal-insulator-metal capacitor, an **antifuse**, and the like.

ST MIM capacitor fabrication dielec film photolithog copper  
**interconnect**

IT Films  
(elec. conductive; high d. metal/insulator/metal capacitor using  
**dual-damascene** copper **interconnect** and  
fabrication for integrated circuits)

IT Electric conductors  
(films; high d. metal/insulator/metal capacitor using **dual-**  
**damascene** copper **interconnect** and fabrication for  
integrated circuits)

IT **Antifuses**  
Dielectric films  
Integrated circuits  
**Interconnections**, electric  
Photolithography  
(high d. metal/insulator/metal capacitor using **dual-**  
**damascene** copper **interconnect** and fabrication for  
integrated circuits)

IT Metals, processes  
RL: DEV (Device component use); PEP (Physical, engineering or chemical  
process); PYP (Physical process); PROC (Process); USES (Uses)  
(high d. metal/insulator/metal capacitor using **dual-**  
**damascene** copper **interconnect** and fabrication for  
integrated circuits)

IT Capacitors  
(metal/insulator/metal; high d. metal/insulator/metal capacitor using  
**dual-damascene** copper **interconnect** and  
fabrication for integrated circuits)

IT Etching  
(stop-layer; high d. metal/insulator/metal capacitor using **dual-**  
**damascene** copper **interconnect** and fabrication for  
integrated circuits)

IT **Interconnections**, electric  
(vias; high d. metal/insulator/metal capacitor using  
**dual-damascene** copper **interconnect** and  
fabrication for integrated circuits)

IT 12033-89-5, Silicon nitride, processes  
RL: CPS (Chemical process); DEV (Device component use); PEP (Physical,  
engineering or chemical process); PYP (Physical process); PROC (Process);  
USES (Uses)  
(high d. metal/insulator/metal capacitor using **dual-**  
**damascene** copper **interconnect** and fabrication for  
integrated circuits)

IT 7440-50-8, Copper, processes  
RL: DEV (Device component use); PEP (Physical, engineering or chemical  
process); PYP (Physical process); PROC (Process); USES (Uses)  
(high d. metal/insulator/metal capacitor using **dual-**  
**damascene** copper **interconnect** and fabrication for  
integrated circuits)

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L9 ANSWER 3 OF 3 HCAPLUS COPYRIGHT 2004 ACS on STN

AN 1997:128079 HCAPLUS Full-text

TI Making a **dual damascene antifuse** structure

IN Zheng, Jiazhen; Chan, Lap

PA Chartered Semiconductor Manufacturing Pte, Ltd., Singapore

PATENT NO.                      KIND      DATE                      APPLICATION NO.      DATE

PI US 5602053 A 19970211 US 1996-628068 19960408  
US 5705849 A 19980106 US 1996-735060 19961018

AB An improved **antifuse** design has been achieved by providing a structure including a pair of alternating layers of Si nitride and amorphous Si sandwiched between 2 **dual damascene** connectors. The structure provides the advantage, over the prior art, that all elec. active surfaces of the fuse structure are planar, so no potential failure spots resulting from surface unevenness can be formed. A process for manufacturing the fuse structure involves fewer masking steps than related structures of the prior art.

ST **dual damascene antifuse** structure prepn

IT Polishing  
(chemical-mech.; in preparation of **antifuse** structures having **dual damascene** connectors)

IT **Antifuses**  
(making a **dual damascene antifuse** structure)

IT **Interconnections** (electric)  
(preparation of **antifuse** structures having **dual damascene** connectors)

IT 7440-21-3, Silicon, processes  
RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)  
(amorphous; making a **dual damascene antifuse** structure containing)

IT 7429-90-5, Aluminum, processes 7440-22-4, Silver, processes 7440-33-7, Tungsten, processes 7440-50-8, Copper, processes 12033-62-4, Tantalum nitride 12033-89-5, Silicon nitride, processes 12642-02-3 25583-20-4, Titanium nitride (TiN) 37359-53-8, Tungsten nitride  
RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)  
(making a **dual damascene antifuse** structure containing)

see WP1X HIT S15, #2